ABSTRACT

An attempt has been made in the thesis to study how the compacted expansive soils behave under swell-shrink cycles. The general background is presented in Chapter 2. Chapter 3 contains the properties of the two soils used, types of tests carried out and methods of presentation of results. The effects of surcharge pressures, initial placement conditions and swell-shrink patterns on cyclic swell-shrink behaviour of the soils and response of soil samples to varying swell-shrink rhythm and varying surcharge pressure during the cyclic swell-shrink process are investigated in Chapter 4. Effects of aging on compressibility and one dimensional swelling behaviour of compacted samples are brought out in Chapter 5. The persistence of aging effect or otherwise when samples were subjected to cyclic swelling and shrinkage are presented in Chapter 6. The swelling and shrinkage paths of soil samples with cycles in terms of void ratio and moisture content are traced in Chapter 7. Chapter 8 presents the detailed procedure for generating the heave and shrinkage profiles using laboratory swell-shrink test results. Chapter 9 synthesizes the types of movements, which an expansive soil would experience.

The studies have confirmed that an equilibrium state is reached after about 4 to 5 cycles of swelling and shrinkage and at this stage, the vertical displacements during swelling and shrinkage is a reversible process establishing an equilibrium band width. The studies have revealed that a soil can recall its past history in terms of cyclic swell potential and equilibrium band width as long as the shrinkage magnitude during the cyclic swell-shrink process does

not exceed its past shrinkage magnitude; otherwise, the behaviour accompanies a fatigue phenomenon before reaching a new equilibrium state. Disturbances caused by unloading disturbs the equilibrium state, but the equilibrium state is re-established if the same stress level is imposed again. Microfabic of expansive soils at equilibrium swollen state showed interweaving structure, whereas, at the equilibrium shrunken state the microfabric comprises of dense clay matrix. Effects of aging are to increase the resistance to compression and reduce the one dimensional swelling of compacted soils. Aging effects get eliminated when samples were subjected to full swelling-full shrinkage cycles but found to persist under full swelling-partial shrinkage cycles giving rise to different equilibrium band widths of the same sample. At the equilibrium state, the swelling and shrinkage paths in w-e coordinates is unique for samples subjected to fixed surcharge pressure and swell-shrink pattern. Effect of higher surcharge pressure is to reduce the ratio of volumetric to axial strain. The heave and shrinkage profiles can be generated using laboratory swell-shrink test results with reasonably good assumptions of swell-shrink pattern with depth. The expansive soil movements are classified into five types by codifying different salient levels. Chapter 10 contains the major conclusions emerging from the investigation reported in this thesis.